Space Weather Technical Forecast

Issued on Thursday, 28 October 2021 at 01:16 Local

This technical forecast provides a four day assessment of space weather events. The probabilities stated below are for reaching or exceeding the given levels. For more information about space weather impacts please see the Met Office Space Weather Scales https://www.metoffice.gov.uk/weather/learn-about/space-weather/uk-scales

Space Weather Forecast Headline: Chance of M-class flares. Chance of a glancing blow from a CME either late on the 30th or early on the 31st October.

Analysis of Space Weather Activity over past 24 hours

Solar Activity: Solar activity has been Low in the 24-hour period, with numerous C-class flares, peaking at C8.5 at 27/0608 UTC, which originated from AR2887. Meanwhile, AR2891 rotating around the northeast limb is likely to have been the source for several far-sided CMEs in the past week, as observed on coronagraph imagery. This new region is one of five on the current disc, with the others all appearing in the southern solar hemisphere. The most noteworthy of these region remains AR2887, which appears as a Dki Beta-Gamma-Delta, although it continues to deliver smaller flares than expected for its classification. A prominence/filament eruption which was observed lifting off the southeast limb at 27/0250 UTC produced a CME, which has been analysed and is currently expected to give a glancing blow at Earth late on day 3 (30th) or early on day 4 (31st). Another filament eruption has been observed lifting off the Earth-facing disc, originating from AR2887 at 27/2215 UTC, awaiting coronagraph imagery for potential CME or Earth-directed component - pending analysis.

Solar Wind / Geomagnetic Activity: The solar wind speed, as measured by DSCOVR at L1, was at ambient levels at the start of the period, rising to slightly elevated levels, just above 400km/s, between 27/0240 UTC until 27/0800 UTC, before reducing back to the current slow-ambient levels. The density was mostly average, below 10 ppcc. The IMF, bt, was weak at 6 nT or below, with all important north-south component, Bz, ranging between +4 and -3 nT. The phi angle was predominantly within a negative sector (towards the Sun). The result of the above solar wind measures was Quiet geomagnetic activity throughout, Kp 0-2.

Energetic Particles / Solar Radiation: The high energy proton flux (greater than 10 MeV) as measured by GOES-16 was at background levels, with no solar radiation storms observed. High energy electron flux (greater than 2 MeV) was predominantly at normal background levels. Associated 24-hour electron fluence was well below the Active (1e8 integrated pfu) threshold on a steady trend, with 1.58e6 integrated pfu recorded at 28/0000 UTC.

Four-Day Space Weather Forecast Summary

Solar Activity: C-class flares are expected, with a chance of M-class flares. This is the result of the complexity of AR2887, and the previous activity of AR2891 rotating onto the disc in the northeast quadrant.

Solar Wind / Geomagnetic Activity: A prominence/filament eruption which was observed in SDO/AIA 304 imagery at 27/0250 UTC produced a CME, which was seen lifting off the southeast limb. This has now been analysed and shows a glancing blow at Earth late on day 3 (30th) or early on day 4 (31st). An enhancement to around 450-500 km/s is possible either later on Day 1 or early Day 2 (28-29 Oct) due to a possible connection with CH15/+. An enhancement was seen at STEREO-A which would correspond with these timings. Geomagnetic activity is

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expected to be mainly Quiet to Unsettled, but with a chance of Active intervals should we observe any faster solar winds on Days 1 or 2. Geomagnetic activity may become enhanced late on day 3 or early day 4 due to glancing blow of a CME, which left the sun early on the 27th, with a chance of Unsettled to Active intervals.

Energetic Particles / Solar Radiation: The high energy (greater than 10 MeV) proton flux is expected to remain at background levels, with a just slightly raised risk from normal due to AR2887 and AR2891. The high energy electron flux (greater than 2MeV) is likely to be at background levels for much of the period, with a low risk of an increase towards Day 4 (30 Oct), although this is now unlikely due to a glancing blow from the 27th CME arriving at Earth. Associated fluence is likely to stay below the Active threshold.

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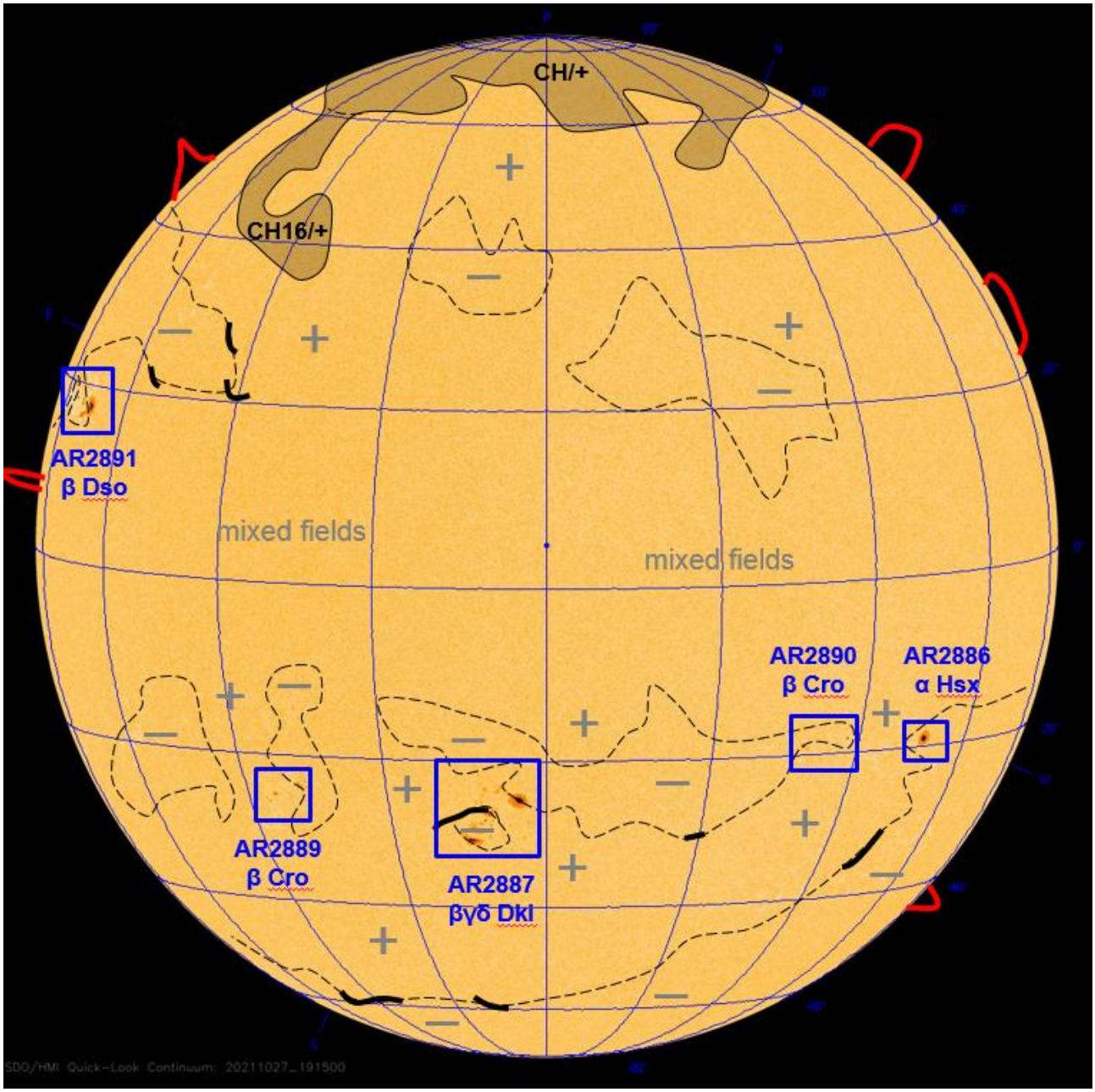
Figure 1. Solar Analysis Valid 27/1915 UTC.



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Key: Filament ___ , Prominence ___ , Magnetic Field Line - - - , Polarity +/-, Coronal Holes: Grey shaded area CHxx +/-, Sunspot groups 25xx - Mt Wilson α-β-βγ-βγδ and Zurich-McIntosh Axx etc.

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Geomagnetic Storms:

A prominence/filament eruption observed in SDO/AIA 304 early on the 27th Oct produced a CME, which has been analysed, with a Chance of a glancing blow at Earth either late on the 30th or early on the 31st Oct. However, the source region for this CME was difficult to ascertain, therefore, confidence is low. No other Earth-directed CMEs feature in the current four-day forecast.

Another filament eruption was observed in the SDO/AIA 304 imagery at 27/2215 UTC, which appears to have originated from AR2887, which until now as appeared muted, despite its complexity. Awaiting coronagraph imagery for any potential CME, which could be Earth-directed, given the location of AR2887 - pending analysis.

The only coronal hole in the forecast is a southern extension of the northern polar crown, CH15/+. This appears to have arrived at STEREO A somewhat later than originally anticipated. However, STEREO A is orbiting at a slightly higher solar latitude than Earth (7N versus 5N for Earth) and ought to be (slightly) more directly in line for effects. It is possible that we may see a slight increase in solar wind speeds either later on Day 1 or early Day 2 (28-29 Oct) to around 450-500 km/s.

Geomagnetic activity is expected to be mainly Quiet to Unsettled, but with a chance of Active intervals should we observe any faster solar winds on Days 1 or 2. Chance of enhanced geomagnetic activity on days 3 and 4 (30-31 Oct), with Unsettled to Active intervals due to the Chance of a glancing blow from a CME.

Geo-Magnetic Storm Probability (Exceedance)	Level	Past 24 Hours (Yes/No)	Day 1 (00-24 UTC) (%)	Day 2 (00-24 UTC) (%)	Day 3 (00-24 UTC) (%)	Day 4 (00-24 UTC) (%)
Minor or Moderate	G1 to G2	No	5	5	2	2
Strong	G3	No	1	1	1	1
Severe	G4	No	1	1	1	1
Extreme	G5	No	1	1	1	1

Geomagnetic Activity - Earthbound Coronal Mass Ejections

Date/time 21.5R (UTC)	Halo: Full or Partial	Source	Source Location	Estimated Speed	Estimated Arrival Time	Comments
27/16:00	Partial Halo	Filament Eruption	SE Limb	350km/s	30/1800UTC	Glancing blow

Figure 2: MOSWOC ENLIL shows a glancing blow from a CME late on the 30th Oct.

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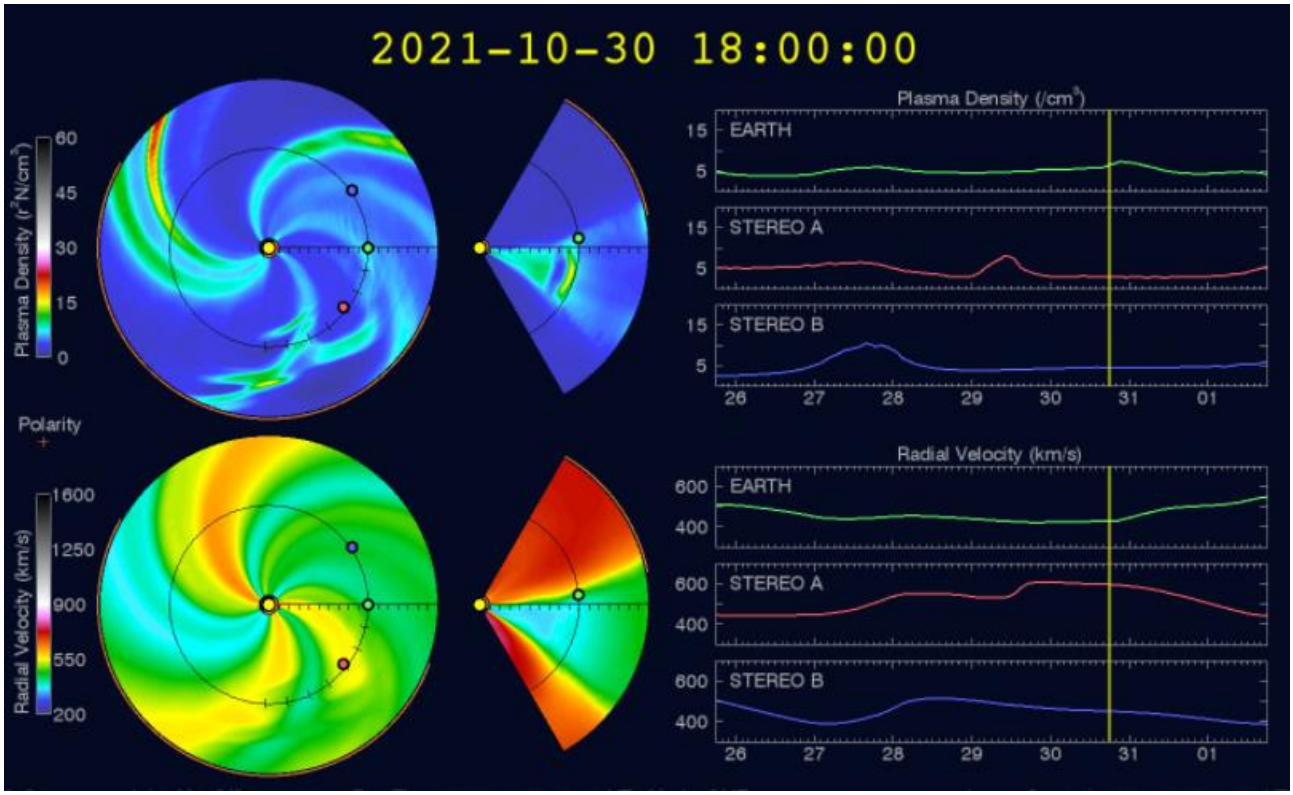
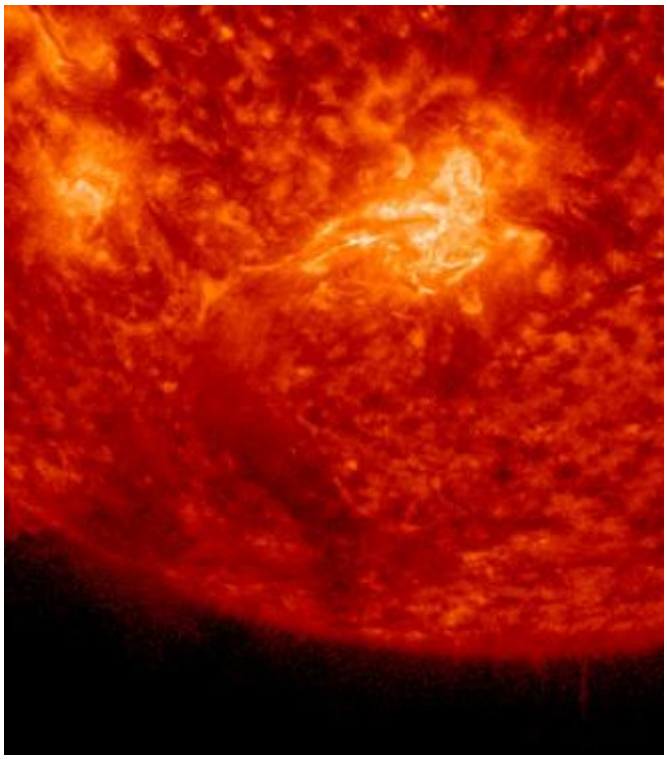


Figure 3: A filament eruption seen in SDO/AIA 304 imagery at 27/2215UTC originating from AR2887, awaiting corongraph imagery for any potential CME and Earth-directed component.



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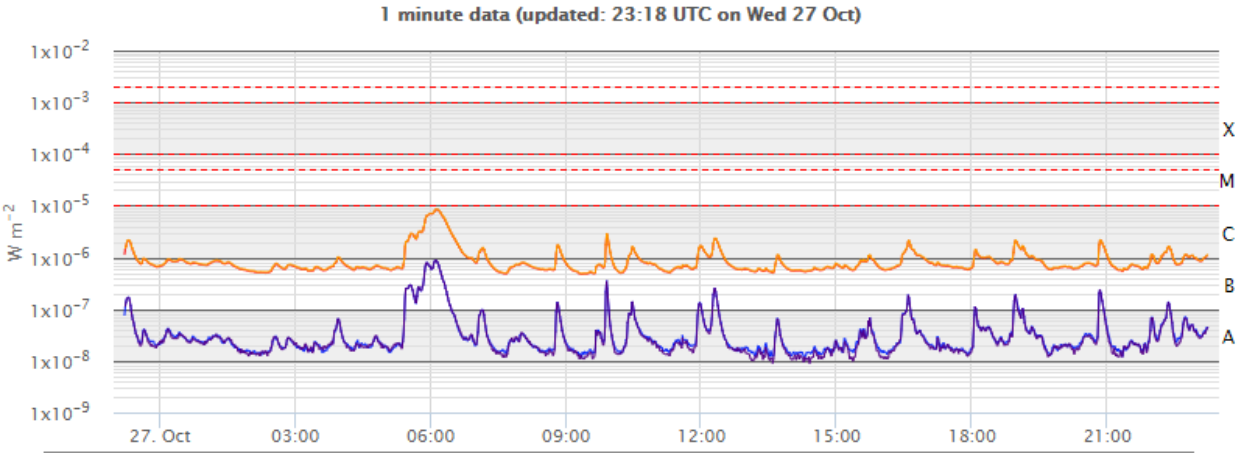
Radio Blackouts - X-Ray Flares:
The X-ray forecast and the risk of Radio Blackouts remain the most notable element of space weather at present. The solar disc has become increasingly congested, particularly in the southern solar hemisphere, which has a near-continuous train east-to-west of sunspot regions in various states of development. The most nominally threatening of these regions remains AR2887, however despite appearances this sunspot group has so far only produced some C-class flares.

The northern solar hemisphere had been quieter until the arrival of a new sunspot region, AR2891, currently rotating around from the northeast limb. This region was the source of two M-class flares on the 26th and potentially the source of some recent far-sided CMEs. The Penticton 10.7cm flux rose as this region arrived to match recent peaks (roughly a month apart) in excess of 100 sfu.

With the arrival of AR2891 the chance of further M-class flares is now at 40%, with a 90% risk of C-class flares.

X Ray Flares	Level	Past 24 Hours (Yes/No)	Day 1 (00-24 UTC)	Day 2 (00-24 UTC)	Day 3 (00-24 UTC)	Day 4 (00-24 UTC)
Probability			(%)	(%)	(%)	(%)
Active	R1-R2 M Class	No	40	40	40	40
Very Active	R3 to R5 X Class	No	2	2	2	2

Figure 4: GOES-16 X-ray flare observations – showing numerous C-class flares mostly originating from AR2891 in the northeast.



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Solar Radiation Storms - (High Energy Protons):

AR2887, although so far having given only C-class flares, has the potential to give larger flares with the attendant risk of an increase in proton flux. As a result the risk of S1 has been raised very slightly above the background level to reflect this. AR2891 has already given a couple of M-class flares, so as it rotates across the disc, the risk of S1 is likely to rise.

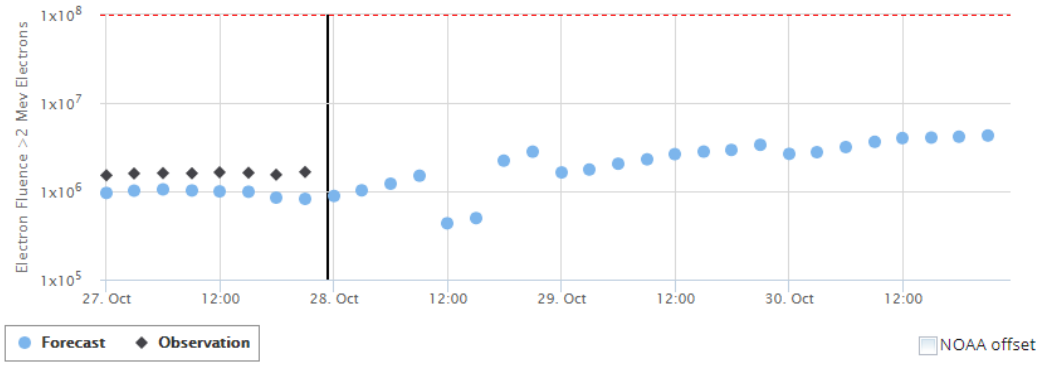
Radiation Storms Probability (Exceedance)	Level (cm^{-2} sr^{-1} s^{-1})	Past 24 Hours (Yes/No)	Day 1 (00-24 UTC) (%)	Day 2 (00-24 UTC) (%)	Day 3 (00-24 UTC) (%)	Day 4 (00-24 UTC) (%)
Active	≥ S1	No	2	2	2	2
Very Active	≥ S3 *	No	1	1	1	1
* S3 ≥ 10 MeV ≥ 1000 pfu and / or ≥ 50 MeV ≥ 10 pfu. (pfu = $cm^{-2}sr^{-1}s^{-1}$)						

High Energy Electrons Event (≥ 2MeV):

The high energy (greater than 2 MeV) electron flux is currently at normal background levels. There is a low confidence increase in wind speeds possible on Days 2 or 3 (28-29 Oct), but it is uncertain whether this will be enough to drive a significant increase in flux levels. Any response if it does occur is likely to be into Day 4 (30 Oct), although this may be thwarted by a glancing blow from a CME which left the sun early on the 27th Oct. Associated fluence is unlikely to breach the Active threshold in this period, with just a very slight chance by the end of Day 4.

GEO Electron Environment Probability (Exceedance)	Level (cm^{-2} sr^{-1} day^{-1})	Past 24 Hours (Yes/No)	Day 1 (00-24 UTC) (%)	Day 2 (00-24 UTC) (%)	Day 3 (00-24 UTC) (%)	Day 4 (00-24 UTC) (%)
Active	≥ 2 MeV ≥ $1x10^8$	No	1	1	1	5
Very Active	≥ 2 MeV ≥ $1x10^9$	No	1	1	1	1

Figure 5: REFM electron fluence observations and forecast.



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